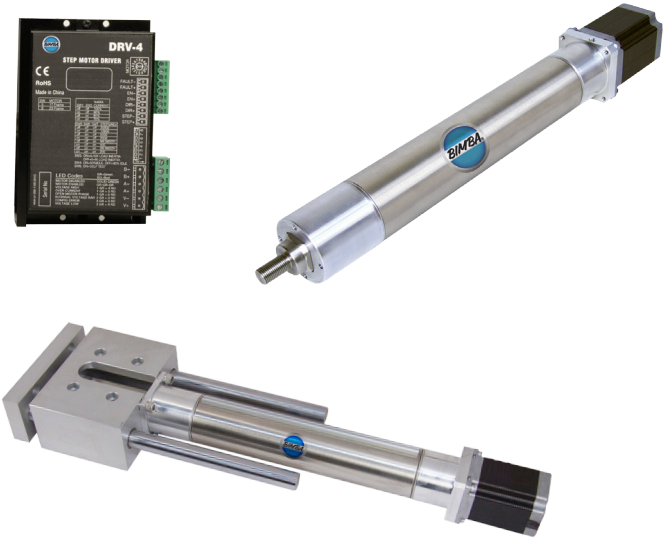
Original Line Electric Actuator, Electric Thruster, Motor, and Driver Quick Start Manual



Please read this manual carefully before implementing your Original Line Electric or Electric Thruster Actuator

Scope of this manual

This instruction manual supports Bimba standard components only. If special motion control components, including but not limited to power supplies, encoders, motors, controls, and drivers, are included based on a customer's specifications or special request, it is the customer's responsibility to consult support materials and technical support specific to these special components provided by the third party manufacturers. Bimba assumes no liability for misuse, misapplication, or support for components that are not the Bimba brand.

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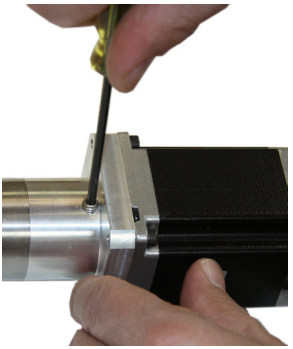
Congratulations on purchasing an Original Line Electric actuator from Bimba. Our OLE and OLET actuators are designed, built, and tested to provide the longest life, greatest durability, highest speed, and greatest thrust per dollar. We look forward to serving your electric actuator needs with the same responsiveness and engineering expertise you are accustomed to receiving for our pneumatic products.

Every OLE and OLET actuator is backed by a one-year warranty. Extend it to a two-year warranty by registering on our website at *www.bimba.com/pdf/OLEwarrantyregistration.pdf.*

1. Actuator-only Models

Installing your motor

a. Remove plug to provide access to coupler. Use a 1/8 inch allen key.



b. Turn the actuator coupler so the clamp screw is aligned with the access hole. Loosen coupler setscrew using allen key. Allen key sizes are identified in Table 1.

> ⚠ Only loosen the clamp screw until it no longer secures the motor shaft. Loosening it too much may result in the screw falling out of the coupler, or binding against the actuator's inside wall.

Table 1

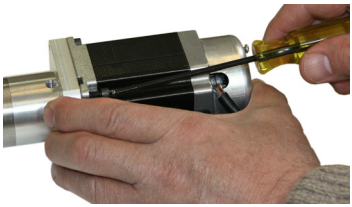
Actuator	Allen Key	Torque
75	5/64"	3.8 in-lbs.
150	3/32"	8 in-ibs.
350	3/32"	8 in-lbs.

Note: Torque range is ± 10%.

c. Mount motor to actuator, slip shaft into coupler. Secure motor to actuator using 4 screws provided. Allen key sizes and torque values are provided in Table 2. Be careful not to turn the coupler.

Table 2		
Actuator	**Allen Key**	**Torque**
75	9/64"	12 in-lbs.
150	9/64"	12 in-lbs.
350	5/32"	35 in-lbs.

Note: Torque range is ± 10%.



d. Tighten coupler clamp screw so motor shaft is secured (refer to Table 1 for torque specification). The coupler clamps around the circumference of the motor shaft. The orientation of any flat (or key-way) on the shaft does not matter.

Tighten the coupler clamp screw to the torque value in Table 1.

e. Replace the coupler access plug.

DO NOT screw the plug in to a hard stop. Only screw it in far enough so that the top of the plug is flush with the outside surface of the actuator.

2. Actuator and Motor Models

All Bimba step motors use the same 8-wire wiring color code convention, as shown below. .

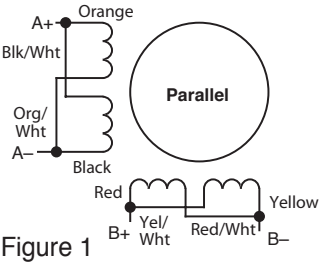


Figure 1

> Warning: Be sure power is off before connecting or disconnecting the motor.

Specifications for Bimba 8-lead 1.8 degree step motors are provided in Table 3.

Table 3

Frame	Winding Connection	Min. Holding Torque (oz-in)	Volts	Amps	Ohms	mH	Rotor Inertia ($oz\text{-}in^2/g\text{-}cm^2$)
17	Parallel	62.3	2.9	1.7	1.7	2.5	0.44/82
	Series	62.3	5.6	0.85	6.6	10.0	0.44/82
	Unipolar	43.9	4.0	1.2	3.3	2.5	0.44/82
23	Parallel	177	2.1	4.2	0.37	1.2	1.64/300
	Series	177	4.2	2.1	1.5	4.8	1.64/300
	Unipolar	125	3.0	3.0	0.75	1.2	1.64/300
23	Parallel	269.1	2.1	4.2	0.5	1.7	2.51/460
	Series	269.1	4.2	2.1	2.0	6.8	2.51/460
	Unipolar	191.2	3.0	3.0	1.0	1.7	2.51/460
34	Parallel	1260	2.72	5.6	0.48	5.4	15.0/2750
	Series	1260	5.43	2.8	1.94	21.6	15.0/2750
	Unipolar	906	3.88	4.0	0.97	5.4	15.0/2750

If you have ordered your actuator with a motor/encoder combination, the encoder specifications are listed in Table 4.

Table 4

Incremental Encoder Specifications	
Power Input	5 V DC, 160 mA
Resolution	2000 pulses per rev.
Output High	2.5 V DC Min.
Output Low	0.5 V DC Max.
Operating Frequency	500 kHz Max.
Operating Temperature	-30 to 115°C
Enclosure Rating	IP40

Encoder connections for Bimba step motors are identified in Table 5. The cable provided has flying leads which can be connected to your controller.

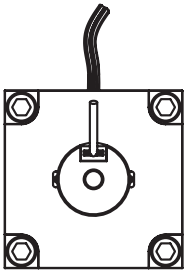


Table 5		
Pin No.	**Wire Color**	**Function**
1	Yellow	Channel A
2	Yellow/White	Channel A-
3	Blue	Channel B
4	Blue/White	Channel B-
5	Orange	Index
6	Orange/White	Index-
7	Green	Not used
8	Green/White	
9	Brown	
10	Brown/White	
11	White	
12	Gray/White	
13	Red	+5 V DC input power
14	Black	Encoder ground
15	Gray	Drain/shield

3. Actuator, Motor, and Driver Models

You will need:

- An OLE or OLET actuator with motor attached.
- A small flat blade screwdriver for tightening the connectors.
- Wires - 18 to 20 gage recommended
- Wire cutter/stripper
- An appropriate DC power supply.

> Warning: Do not apply power until all connections are made.

The DRV-4 accepts power supply voltages from 24 to 48 VDC, while the DRV-8 accepts power supply voltages from 24 to 75 VDC. The current demand will never exceed double the motor current (see Table 3, Amps column). However, the DRV will convert a high voltage low current power supply into a lower voltage higher current power supply. A 24V 4A supply will perform similarly to a 48V 2A supply. Use Table 7 below as a guideline.

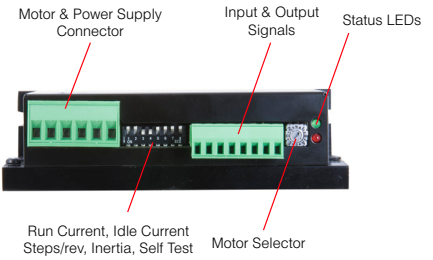
> Use unregulated power supplies without overvoltage protection to avoid problems with regeneration during rapid deceleration.

Table 7

OLE	Drive	Power Supply Voltage	Bimba Motor	Parallel Current Draw	Parallel Current Draw Max.	24V Power Supply Amperage	48V Power Supply Amperage	Max Amps per Phase
-75	DRV-4	24-48	17 frame	1.7	3.4	4	2	4.5
-75	DRV-4	24-48	23 frame	4.0	4.5	4	2	4.5
-150	DRV-8	24-75	23 frame	4.2	8.4	8	4	7.8
-350	DRV-8	24-75	34 frame	5.6	11.2	12	6	7.8

a. Mount your drive

Mount the drive using #6 screws. Installing on a metal surface (recommended) helps dissipate heat. Forced air flow from a fan is also good practice.


Motor & Power Supply Connector
Input & Output Signals
Status LEDs
Run Current, Idle Current Steps/rev, Inertia, Self Test
Motor Selector

Warnings:

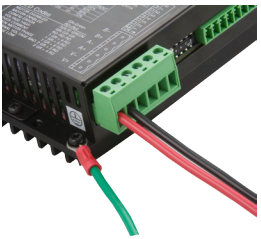
- Do not install drive where ambient air is more than 104° F.
- Do not install drive where there is no air flow
- Do not install drive where drive can get wet.
- Do not install drive where electrically conductive material can fall on the driver.
- Drives must be mounted at least one-half inch apart.

b. Connect the DC power supply to the driver -- Do not apply power

Warning: Observe proper polarity when connecting wires.

I. Make sure the power supply is not on. Connect V+ and V- from the power supply to the V+ and V- terminals of your driver.

II. Ensure a proper earth ground connection by using the screw on the left side of the chassis. All system components must be grounded to a single point common earth ground.

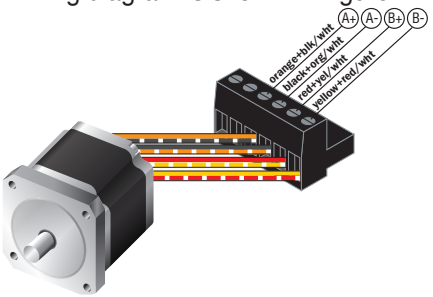


If using an external fuse, we recommend the following in-line with the V+ connection:
DRV-4: 3AG, 4 amp (Littlefuse 313004P)
DRV-8: 3AG, 6.25 amp (Littlefuse 3136.25P)

c. Connect the motor to the driver

Warning: Never connect or disconnect the motor when power is applied.

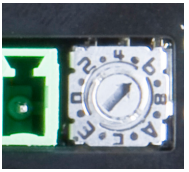
Connect OLE or OLET eight lead motors in parallel, as shown below. If using a motor from another source, please refer to your motor specs for wiring information. A motor wiring diagram is shown in Figure 1.



d. Set rotary switch for the motor selected

(This is normally set by the factory for the motor specified.)

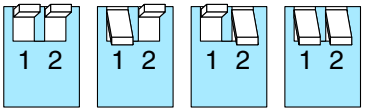
Turn the rotary switch to the number that represents the motor you have. This sets current and anti-resonance settings for optimum performance.



OLE	Bimba Motor Frame	Option Code	Setting
-75	17 frame	P1, E1, Y1, Z1	5
-75	23 frame	P2, E2, Y2, Z2	7
-150	23 frame	P2, E2, Y2, Z2	6
-350	34 frame	P3, E3, Y3, Z3	F

e. Adjust running and idle current

Switch 1 and 2 set the running current to 70%, 80%, 90% or 100% of the motor's rated maximum current.

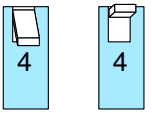


- *Use 100% position in most applications (factory default)*

- Use lower setting during initial setup to avert accidental damage

- Use lower settings to address safety issues
- Use lower settings to reduce motor temperature

Switch 4 sets the idle current to either 50% or 90% of the selected running current. *Factory default is 90%.*

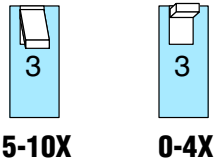


- Use lower settings for self locking threads (OLE 12, 16, and 20 leads).
- Use lower settings to reduce motor temperature
- Use higher settings for full holding torque

f. Set load inertia

Switch 3 chooses between two load inertia ranges.

This information is used in the anti-resonance configuration.

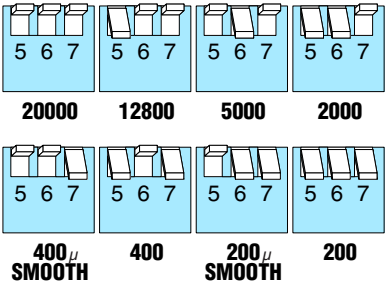


- Values are multiples of rotor inerta (see Table 3)
- *Use 0-4x for smaller (0.2" or smaller) leads and shorter strokes (factory default)*
- Use 5-10x for longer (0.25" or larger) leads and greater loads
- 5-10x may reduce performance.

g. Select step resolution

There are 4 microstep resolutions to choose from as well as full and half step

- 200
- 200μ (microstep emulation) factory default
- 400
- 400μ (microstep emulation)
- 2000
- 5000
- 12800
- 20000



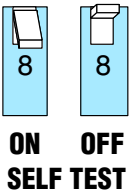
The 200μ and 400μ settings use microstep emulation to provide smooth rotation at low speeds. Microstep emulation imparts a slight delay to the motion. If this is not acceptable, use the non-filtered 200 or 400 settings.

Microstepping provides smoothest rotation. However, a faster step pulse rate (frequency) is required for a given RPM as shown in Table 8 below.

Table 8			
Pulses per revolution	**Degrees per step**	**Pulse frequency required for 300 RPM**	**Pulse frequency required for 3000 RPM**
200	1.8	1,000 Hz	10,000 Hz
400	0.9	2,000 Hz	20,000 Hz
2000	0.18	10,000 Hz	100,000 Hz
5000	0.072	25,000 Hz	250,000 Hz
12800	0.028	64,000 Hz	640,000 Hz
20000	0.018	100,000 Hz	1,000,000 Hz

h. Apply power and run self test

The DRV-4 and DRV-8 have built in Self Test functions. When switch 8 is moved to the ON position, the drive will automatically rotate the motor back and forth, two turns in each direction. This feature can be used to confirm that the motor is correctly wired, selected and operational. Factory default is “OFF.”



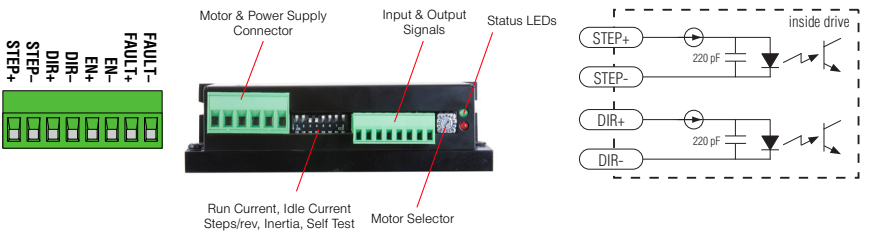
i. Connect input signals

The drives have three inputs:

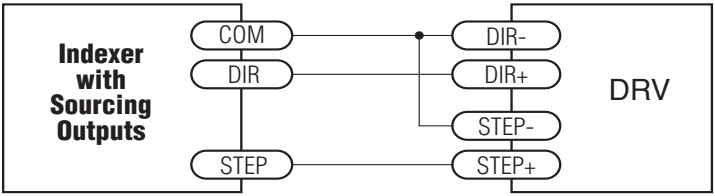
- STEP: a high speed digital input for step pulse commands, 5-24 volt logic
- DIR: a high speed digital input for the direction signal, 5-24 volt logic
- EN: a 5-24V input for commanding the removal of power from the motor

> STEP and DIR inputs can be converted to STEP CW and STEP CCW by moving the internal jumper S3. For detailed instructions, go to Step “K” of this section.

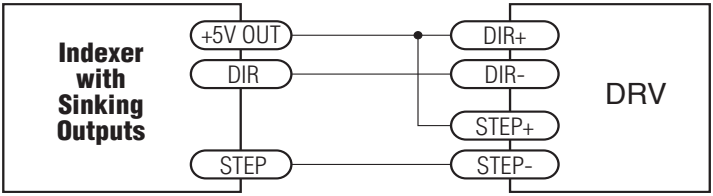
Refer to the illustration below for identification of step, direction, and enable inputs on the driver screw terminal blocks.



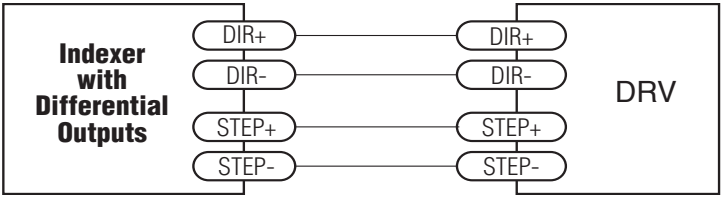
Connection Examples: STEP & DIR



Connecting to indexer with Sourcing Outputs



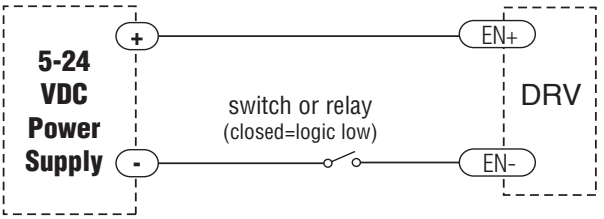
Connecting to Indexer with Sinking Outputs



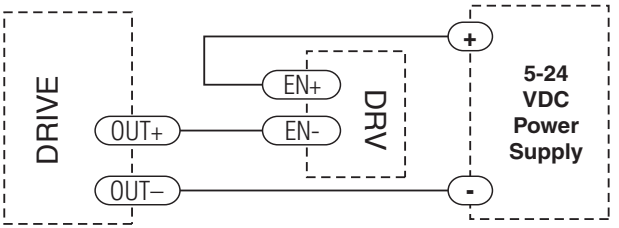
Connecting to Indexer with Differential Outputs
(Many High Speed Indexers have Differential Outputs)

Connection Examples: EN

The 5-24 V EN input disables power to the motor.

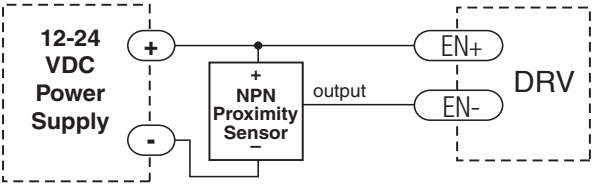


Connecting an Input to a Switch or Relay



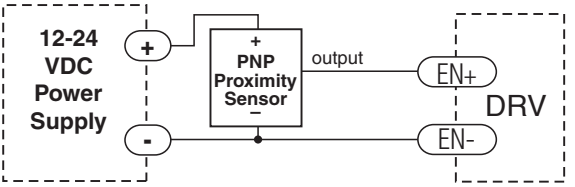
Connecting another drive to EN

(When output closes, input closes)



Connecting an NPN Type Proximity Sensor to an input

(When prox sensor activates, input closes)



Connecting a PNP Type Proximity Sensor to an input

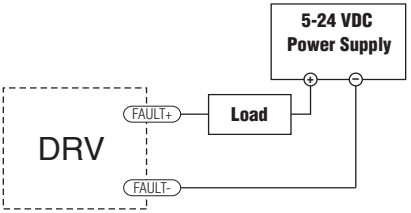
(When prox sensor activates, input closes)

j. FAULT output

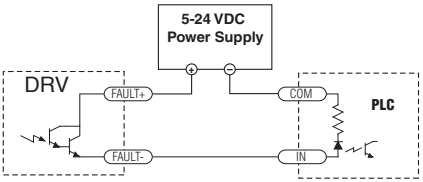
The DRV drives feature a digital FAULT output. This output closes to signal a fault condition.

This output can be used to drive LEDs, relays and the inputs of other electronic devices like PLCs. The “+” (collector) and “-” (emitter) terminals of the output transistor are available at the connector. This allows you to configure the output for current sourcing or sinking. Diagrams of each type of connection follow.

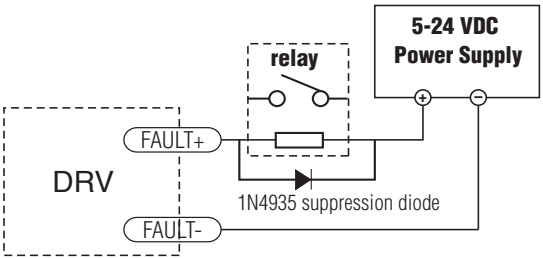
> Do not connect the output to more than 30 VDC.
> The current through the output terminal must not exceed 80 mA.



Sinking Output



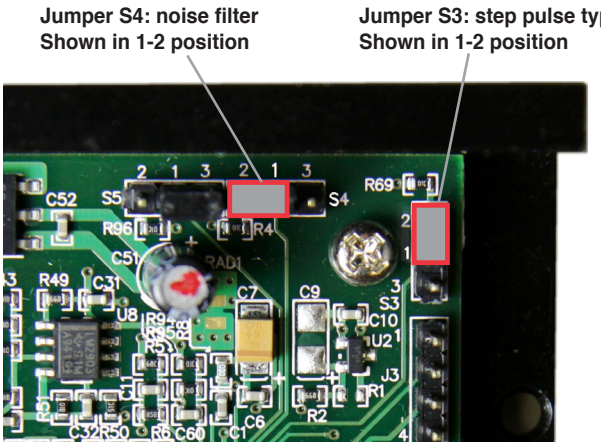
Sourcing Output



Driving a Relay

k. Set step pulse type

Most indexers and motion controllers provide motion commands in the “Step and Direction” format. The Step signal pulses once for each motor step and the direction signal commands direction. However, a few PLCs use a different type of command signal: one signal pulses once for each desired step in the clockwise direction (called STEP CW), while a second signal pulses for counterclockwise motion (STEP CCW). The drives can accept this type of signal if you remove the cover and move jumper S3 from the “1-2” position to the “1-3” position. Factory default is the 1-2 position. As you can see in the image, the jumper terminals (2, 1, 3) and S3 and S4 designators are printed in white on the circuit board.



l. Step pulse noise filter

Electrical noise can cause the drive to think that one step pulse is two or more pulses, resulting in extra motion and inaccurate motor and load positioning. To combat this problem, the drive includes a digital noise filter on the STEP and DIR inputs. The default factory setting of this filter is 150 kHz.

If you are operating the drive at high speeds with step rates above 150 kHz, remove the cover and move jumper S4 from the 150 kHz position (1-3) to the 2 MHz position (1-2) as shown below.

Your maximum pulse rate will be the highest motor speed times the steps/rev. For example, 40 revs/second at 20,000 steps/rev is 40 x 20,000 = 800 kHz. Please consider this when deciding if you must increase the filter frequency.

m. Technical specifications

Amplifier

Digital MOSFET. 20 kHz PWM. Suitable for driving two phase and four phase step motors with four, six or eight leads.

Supply voltage:

DRV-4
24-48 VDC
Under voltage alarm: 20 VDC
Over voltage shutdown: 60 VDC
DRV-8
24-75 VDC
Under voltage alarm: 20 VDC
Over voltage shutdown: 85 VDC

Motor current:

0.5 to 7.8 amps/phase peak of sine (DRV8)
0.25 to 4.5 amps/phase peak of sine (DRV4)

Digital Inputs

Optically isolated, 5 - 24V logic. Sourcing, sinking or differential signals can be used.
Minimum “on” voltage: 4 VDC.
Maximum voltage: 30 VDC.
Input current: 5 mA typ at 4V, 15 mA typ at 30V.

Fault Output

Photodarlington, 80 mA, 30 VDC max. Voltage drop: 1.2V max at 80 mA.

Physical

1.3 x 3.0 x 4.65 inches (33 x 75.5 x 118 mm) overall. 10.8 oz (305 g) including mating connectors.
Ambient temperature range: 0° C to 40° C.

Mating Connectors

Motor/power supply: PCD P/N ELV06100 (Phoenix Contact 1757051), included with drive.

Signals: PCD P/N ELVH08100 (Phoenix Contact 1803633), included with drive.

n. Alarm codes

In the event of a drive fault or alarm, the green LED will flash one or two times, followed by a series of red flashes. The pattern repeats until the alarm is cleared. You may clear the alarm by cycling power off and then on.

	Code	Error	Action Required
Ⓖ	solid green	no alarm, motor disabled	open enable input
ⒼⒼ	flashing green	no alarm, motor enabled	none
ⓇⓇ	flashing red	configuration or memory error	repair
ⒼⓇⓇⓇⓇ	1 green, 4 red	power supply voltage too high	reduce power supply voltage
ⒼⓇⓇⓇⓇⓇ	1 green, 5 red	over current/short current	check motor connections
ⒼⓇⓇⓇⓇⓇⓇ	1 green, 6 red	open motor winding	check motor connections
ⒼⒼⓇⓇⓇ	2 green, 3 red	internal voltage out of range	repair
ⒼⒼⓇⓇⓇⓇ	2 green, 4 red	power supply voltage too low	increase power supply voltage

Troubleshooting Guide and FAQ

Problem: Actuator does not move when step motor is energized.

Solution: Step motor windings may be shorted. Use an Ohmmeter to measure the resistance between pairs of windings (should be infinite) and between the leads of each winding (should be the same for each winding). Use your motor's wiring diagram to identify the correct leads. If windings are shorted, the motor must be replaced.

Problem: Actuator operation is stiff, seems to be binding.

Solution: Check for dents on the body tube, motor end bell, and damage to the square rod. If there are signs of visible damage, the actuator or motor or both may need to be replaced. Dents on the motor shaft or endbells may cause the rotor to seize or rub, producing binding and stiff operation. While the nut of the OLE actuator is self-lubricating, rod lubrications is recommended at regular intervals. Use Bimba HT-99 grease.

Problem: Can I use switches with my OLE for end of stroke sensing?

Solution: All OLE actuators have magnetic pistons. OLE actuators can use the same switches as Original Line pneumatic cylinders. Refer to the Bimba catalog for switch recommendations.

Problem: The motor gets hot.

Solution: Step motors tend to run hot (the actual maximum case temperature is 80° C). However, the motor should not get too hot to touch. If it is overheating, the drive current may be set too high. All standard OLE step motors are 8-wire motors. Refer to Table 3 in this manual for required drive current levels. Also consider duty cycle; reduce either the running current, idle current, or duty cycle. Instructions for adjusting idle and running current are provided in section 3.e.

Problem: The motor is not producing enough torque or it stalls at low speeds.

Solution: If the motor previously ran well, check the resistance of the windings. Use an Ohmmeter to measure the resistance between different windings (should be infinite) and between the leads of each winding (should be the same for each winding). Use your motor's wiring diagram to identify the correct leads. If windings are shorted, the motor must be replaced.

If lack of torque is observed at the initial start up with a load and desired speeds are not reached, check connections between the motor and drive and check drive settings.

Inspect the motor and rotate the shaft when the motor is not connected. If you feel any rubbing or there are any dents on the motor, there is probably an alignment problem and the motor may need to be replaced.

If the rotor was removed from the stator, it could have been demagnetized. The motor would need to be replaced.

If you still cannot solve the problem, the size of your power supply (voltage output) may need to be greater. When a step motor rotates, it acts like a generator pumping voltage (back EMF) back into the drive. Back EMF rises as motor speed and inductance increase and can cause a stall. The solution is to either change from a series to a parallel connection (series connections quadruple inductance) or use a power supply with a higher output voltage.

Problem: The motor doesn't produce any holding torque.

Solution: Make sure that line power is on, the drive is powered up, and the motor phases are connected correctly to the drive.

Problem: The motor (actuator) oscillates back and forth at low speeds.

Solution: This is due to resonance, common between 1-4 rps. If this is observed with no load, add a load to the motor (the load will dampen out resonance). Changing from full-step to half-step or microstepping will also solve resonance problems.

Step and Direction Drives

Note: Please read your manual first before and during your setup. Bimba manuals, available at *www.bimba.com/OLE/manuals*, are short, to the point, and comprehensive.

Problem: The drive's power LED does not illuminate when power is applied.

Solution: Check the fuse and replace if necessary with one of the extra fuses included with your drive. If you have no fuses or continuously blow fuses, call Bimba Technical Support. Check your power supply to be sure it is not providing an excessively high voltage to the drive.

Problem: The motor runs then suddenly dies. The connections are correct.

Solution: Turn off power. Refer to your motor wiring diagram. Disconnect the motor. Using an ohmmeter, measure the resistance between the A+ and A- and B+ and B- terminals. The reading should be in the mega-Ohms. If resistance is low, the H-bridge is damaged and the drive must be returned on a RGA (Returned Good Authorization). If the resistance is normal, inspect the board for any visible damage to the components and check the motor for a short circuit in the windings.

Problem: The motor does not move when a step signal is sent to the drive.

Solution: If the enable input is on (low with respect to a 5-24 volt signal), it will disable the motor. Do not connect anything to the enable input if there is no reason to disable the motor.

Problem: The motor will not run slow enough with a potentiometer connected to my drive (it has an internal oscillator).

Solution: Some drives' internal potentiometers cannot be adjusted to zero speed. Check the specifications in the manual that came with the drive.

Problem: At startup, the motor does not run although the wiring is correct.

Solution: Make sure that dip switches and jumpers are set properly. Read your driver manual carefully.

Problem: System not working properly.

Solution: Troubleshoot by replacing the drive and see if the problem persists. Please read your drive manual before and during your setup.

Bimba manuals, concise and comprehensive, are available for download at our website, *www.bimba.com*.

Bimba Manufacturing Company
Monee, Illinois 60449-0068
Tel: 708.534.8544
Tech Support: 800.44BIMBA
Fax: 708.235.2014
support@bimba.com

www.bimba.com

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